Design of Integrated Bandpass Filter-Vivaldi Antenna for Microwave Applications

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Abstract – *This paper presents the proposed design of Integrated Bandpass Filter-Vivaldi Antenna for microwave system applications. Both of these passives components play important roles as the front-end device in transceiver technology. Conventionally, antenna and filter are connected separately leading to impedance mismatch that would affect the whole performance of the overall system. To overcome this problem, an integrated filter-antenna design is proposed, where both devices are combined together into a single sub-module. The proposed design would benefit so much in terms of miniaturization and cost. The proposed antenna and filter used in this research is the antipodal Vivaldi antenna and an Open-Loop Resonator Bandpass Filter (OLRBPF) operating at 2.4GHz frequency band. The structure is constructed on an FR4 substrate with a thickness of 1.6 mm and permittivity of 4.7 using cascaded and co-design method. The proposed designs are simulated in Agilent Advance Design System (ADS2016). It is shown that the size of both devices is reduced, the performance of the filter antenna is also enhanced in terms of directivity up to 9.538dBi (co-design) and 5.860 dBi (cascaded).*

Keywords*: integrated, Vivaldi, Filter, cascaded, co-design*

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I. Introduction

In most communication and radar systems, filters and antennas are critical components and usually needed to function simultaneously [1]. In general, filter is used to receive and reject any signals that fall outside the required desired frequency range, while antennas are electrical devices used to convert electrical power to radio waves. The optimal size of an antenna depends on the frequency of a signal and the wavelength, the higher the frequency, the shortest wavelength required in the design process. They are always treated as an individual device and mostly connected via transmission lines which might increase loss and circuit area. Thus, one of the solutions is by integrating both devices into a single module. This would solve the current problem involving impedance mismatch, reducing both loss and the size thus enhancing the overall performance of the system.

The idea of integrating filter and antenna has caught a lot of attention among the researchers [2][3][6]. Besides, dealing with the impedance mismatches is one of the crucial concerns that all the designers should take seriously in designing integrated filter-antenna due to separate interconnection between them that will contribute to extra impedance transformation needed [3]. Recent research shows that different researchers introduced different design and method on integrating filter and antenna. For example, the co-design approach for integrating filter and antenna for UWB application, resulted in compact size, range of gain between 2.8dBi to 4.6dBi in the bandwidth of S_{11}<-10dB [3]. Not only that, the cascaded approach or known as traditional method also still being used in integrating filter-antenna that serve in [4].

In this paper, integrated filter-antenna is discussed with two design methods proposed; cascaded and co-design approach to combine both devices into a single sub-module. These devices are fabricated on dielectric substrate of FR4 with the thickness of 1.6mm and dielectric permittivity of 4.7.